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# Screening Heroin Smokers Attending Community Drug Services for COPD



*Hassan Burhan, MD; Ryan Young, MD; Tara Byrne, BSc; Robert Peat, BSc; Jennifer Furlong, MSc; Susan Renwick, MPH; Tristan Elkin, MD; Sandra Oelbaum, MD; and Paul P. Walker, MD*

**BACKGROUND:** Heroin smoking is associated with deprivation, early onset severe emphysema, premature morbidity and mortality, and high use of health care, but individuals engage poorly with traditional health services.

**METHODS:** In this cross-sectional study, we screened a population of heroin smokers, prescribed opiate substitution therapy by community drug services, for airway disease. We assessed drug exposure, respiratory symptoms, health status, and COPD prevalence. Subjects completed spirometry, completed Medical Research Council (MRC) Dyspnea Scale, COPD Assessment Tool (CAT) questionnaire, recorded drug exposure, and provided feedback.

**RESULTS:** A total of 753 people (73% of those approached) completed screening, with 260 participants (35%) having COPD using $FEV_1/FVC < 0.7$ and 293 (39%) participants having COPD using the lower limit of normal. A further 112 participants (15%) had asthma-COPD overlap (ACO) with features of COPD and asthma. Compared with those with normal spirometry, participants with COPD were more breathless (MRC score 3.1 vs 1.9; $P < .001$) and had worse health status (CAT score 22.9 vs 13.4; $P < .001$), respectively. Individuals with COPD had smoked cigarettes ($P < .001$), heroin ($P < .001$), and crack ($P = .03$) for longer and were more likely to still be smoking heroin ($P < .01$). Feedback was strongly positive, with 92% of respondents happy for other health-care appointments to be colocated with drug key worker appointments.

**CONCLUSIONS:** Most heroin smokers had COPD or ACO, most commonly mild to moderate disease. In high-risk areas, screening this population provides an opportunity to reduce symptoms and risk. Anchoring respiratory health screening to drug center appointments delivers high completion and satisfaction and is an appropriate model for screening other hard-to-reach populations.

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**KEY WORDS:** addiction; COPD; drug abuse; spirometry

FOR EDITORIAL COMMENT, SEE PAGE 247

**ABBREVIATIONS:** ACO = asthma-COPD overlap; CAT = COPD Assessment Tool; LLN = lower limit of normal; MRC = Medical Research Council

**AFFILIATIONS:** From the Royal Liverpool University Hospital (Dr Burhan), Liverpool, England; the University Hospital Aintree (Drs Young and Walker), Liverpool, England; the Addaction (Ms Byrne and Dr Oelbaum), Liverpool, England; the Liverpool Heart and Chest Hospital (Mr Peat and Ms Furlong), Liverpool, England; and the Liverpool Clinical Commissioning Group (Ms Renwick and Dr Elkin), Liverpool, England.

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**CORRESPONDENCE TO:** Paul P. Walker, MD, Clinical Science Building, University Hospital Aintree, Lower Lane, Liverpool, L9 7AL, England; e-mail: ppwalker@liv.ac.uk



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Over the last 3 decades, inhalation rather than injection has become the predominant method of illicit heroin use.[1-3] This is partly in response to medical problems associated with IV injection, including systemic infection, thromboembolic disorders, and transmission of bloodborne viruses.[4] This change in delivery route has led to a marked increase in respiratory disease in this population. Modest-sized studies have shown a high level of respiratory symptoms,[5-7] a lack of accurate diagnosis, and significant undertreatment.[6] Some individuals experience severe emphysema associated with premature morbidity and mortality.[8-10] There is a consequent impact on the local health economy with high levels of COPD hospitalization[11] and readmission, with greater physiologic impairment seen at the time of presentation to hospital.[12] The impact is greater in areas with higher levels of socioeconomic deprivation[13] and is likely to increase in future as a consequence of, in many places, dramatic increase in inhalation of heroin in the 1990s.[14]

Addressing the health-care needs of heroin smokers is challenging because their lifestyle is often chaotic and individuals frequently fail to engage with traditional models of health-care delivery, including disease prevention and screening. Receipt of methadone prescriptions is contingent on regular engagement with drug key workers, and attendance at community drug services, in particular key worker appointments, is very high. In the United Kingdom there is a focus on recovery from drug addiction rather than control,[15,16] and colocating physical health interventions with existing drug services presents an attractive model to address current challenges.

This cross-sectional study examines whether large-scale COPD screening at community drug centers is deliverable and acceptable to the individuals. We aimed to ascertain the acceptability and uptake of screening and to establish the prevalence of COPD in a large cohort of heroin and crack cocaine smokers and examine the relationship between drug exposure and lung damage.

## Methods

This work was a service evaluation and improvement project funded by the local UK National Health Service health-care provider, the Liverpool Clinical Commissioning Group. All potential participants had a shared health-care agreement between their primary care team and Addaction (a local independent drug service provider) and were currently or recently treated with methadone or buprenorphine. Participants attended one of 31 different sites (either their local primary care clinic or a centralized specialist drug service clinic) and were current or previous smokers of heroin or crack cocaine. Every participant was offered a single study appointment at their usual site that was arranged at the time of a regular appointment with their drug key worker. Participants prescribed inhalers were asked to omit them before the visit.

In advance, key workers were educated about COPD, the role of spirometry, and the study. They discussed and encouraged participation with their participants and provided a study information leaflet. The project was designed with and supported by the Addaction Service User Forum. Liverpool Local Medical Committee and primary care practices also supported the study. This study was conducted in accordance with the amended Declaration of Helsinki. We received favorable ethical committee opinion and Health Research Authority approval (No. 16/NW/0295). People willing to participate provided written informed consent.

All assessments were performed by a trained physiologist from a local hospital. Study participants had pulse oxygen saturation measured, and a demographic questionnaire was completed. Subjects completed the COPD Assessment Tool (CAT) quality of life questionnaire, the Medical Research Council (MRC) Dyspnea Scale score, a questionnaire detailing respiratory symptoms, current and previous respiratory diagnoses and treatment, and a questionnaire detailing use of cigarettes, heroin, crack, and cannabis. Subjects were asked not to take a short-acting bronchodilator within 8 h of the visit or a long-acting bronchodilator within 24 h. If the subject did not use inhalers or had not taken their bronchodilator(s) as directed, they performed prebronchodilator spirometry. If the spirometry was abnormal, they were given 400 μg salbutamol administered via a Volumatic Spacer Device (Allen and Hanburys), and spirometry (postbronchodilator) was then repeated after an interval of at least 15 min. If the subject had taken a bronchodilator before the visit, they did not perform prebronchodilator spirometry but were given 400 μg salbutamol, and spirometry (postbronchodilator) was performed after an interval of at least 15 min. Spirometry was performed in accordance with the European Respiratory Society guidelines[17] using a Spirostik spirometer (Love Medical/Geratherm).

On average, the study visit lasted 30 min. The study took place between December 2015 and June 2016.

Subjects were categorized as having COPD, asthma, asthma-COPD overlap (ACO), restrictive, or normal based on spirometry and past physician diagnosis.

COPD was based on postbronchodilator airflow obstruction ($FEV_1$/FVC ratio $< 0.7$) without major reversibility in people without a prior physician diagnosis of asthma or in people with a past physician diagnosis of COPD.

Asthma was based on reversible airflow obstruction ($FEV_1$/FVC ratio $< 0.7$ which normalized or an increase in $FEV_1 \geq 400$ mL with salbutamol) or normal spirometry plus a prior physician diagnosis of asthma.[18]

ACO was based on postbronchodilator airflow obstruction without major reversibility in people with a prior physician diagnosis of asthma.

Restricted was defined as a postbronchodilator $FEV_1$/FVC ratio $\geq 0.7$ with an FVC $< 80\%$ of predicted value.

The Global Initiative for Chronic Obstructive Lung Disease guideline[19] was used for classification of COPD severity.

The reference range used was from the European Community for Steel and Coal.[20]

An additional analysis was performed using the Global Lung Function Initiative[21] to define airflow obstruction using the lower limit of normal (LLN).

Spirometry was not performed if the individual had been treated for an exacerbation of asthma, COPD, or a lower respiratory tract infection within the previous 4 weeks. A small number of subjects were unwilling to complete a specific study measure.

As part of the consent process, participants were asked for permission to forward the results to their primary care physician, provided with a copy of the result, and encouraged to see their primary care physician about the study results.

### Statistical Analysis

Statistical analysis was performed using Statistical Package for the Social Sciences version 24.0 (IBM). Data are presented as mean ± SD. $P < .05$ was considered significant.

Data were normally distributed. Three- or four-group comparison of continuous variables was performed using a one-way analysis of variance and post hoc testing using the Tukey test. Three- or four-group comparison of categorical variables was performed using the $\chi^2$ test. Correlations were examined using Pearson correlation coefficient.

## Results

A total of 1,082 participants were eligible for the study, and 789 attended and agreed to participate (73% of the total population). Study flow is shown in Figure 1. Thirty-six participants (5%) were unable to perform spirometry, most because of a lower respiratory tract infection and/or an exacerbation of asthma or COPD.

The baseline characteristics of the whole group are shown in Table 1. The overall mean age was 47 ± 7 years, and 553 participants (70%)

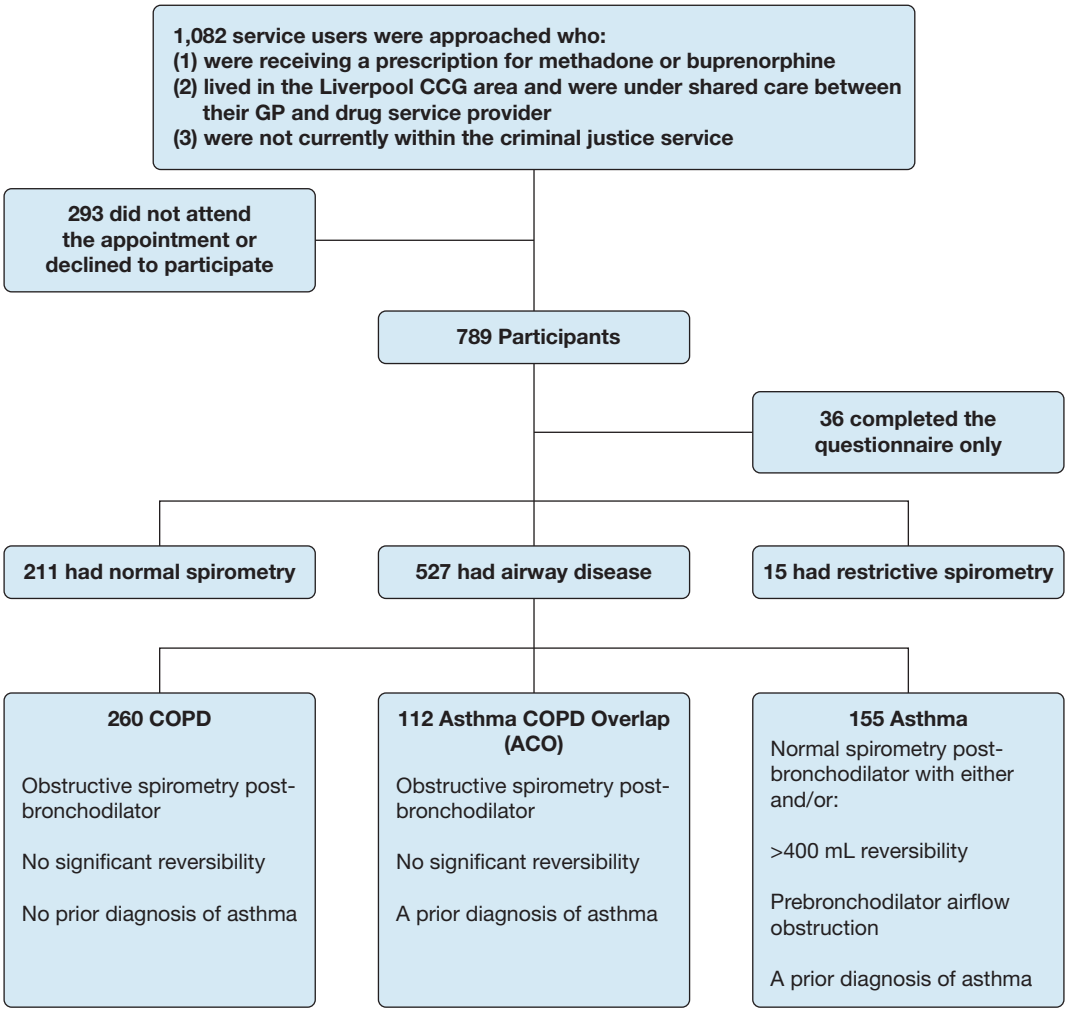


Figure 1 – *Consolidated Standards of Reporting Trials diagram detailing study flow and diagnosis. CCG = Clinical Commissioning Group; GP = general practitioner.*

**TABLE 1** ] Baseline Characteristics of the 789 Participants in the Study

| Characteristic | Value |
|---|---|
| Sex, male/female | 553 (70)/236 (30) |
| Age, y | 47.4 ± 6.5 |
| BMI, kg/m$^2$ | 25.1 ± 6 |
| Oxygen saturation, % | 97 ± 2 |
| MRC Dyspnea Scale score | 2.7 ± 1.3 |
| CAT score | 19.5 ± 10.5 |
| Prebronchodilator spirometry (n = 605) | |
| $FEV_1$, L | 2.93 ± 0.93 |
| $FEV_1$, % predicted | 86.9 ± 23.3 |
| FVC, L | 4.34 ± 1.11 |
| FVC, % predicted | 106 ± 18.5 |
| $FEV_1$/FVC | 0.67 ± 0.12 |
| Postbronchodilator spirometry (n = 753) | |
| $FEV_1$, L | 2.82 ± 1.03 |
| $FEV_1$, % predicted | 84.9 ± 26.2 |
| FVC, L | 4.27 ± 1.2 |
| FVC, % predicted | 105.7 ± 20.5 |
| $FEV_1$/FVC | 0.65 ± 0.14 |
| Cigarette smoking (current/ex/never) | 697/82/10 |
| Pack-years (one pack of 20 cigarettes/d for 1 y) | 28.8 ± 19.9 |
| Heroin smoking (current/ex/never/not known) | 389/384/8/8 |
| Wrap-years (20 wraps/wk for 1 y) | 22.3 ± 31.5 |
| Crack smoking (current/ex/never/not known) | 195/459/125/10 |
| Rock-years (20 rocks/wk for 1 y) | 15.9 ± 32.6 |
| Cannabis smoking (current/ex/never/not known) | 226/428/126/9 |
| Joint years (one joint/d for 1 y) | 86.9 ± 144.3 |
| Ever injected heroin (yes/no/not known) | 313/235/241 |
| Current methadone dose, mL/d (n = 438) | 43.3 ± 21.3 |

The entire population did not complete prebronchodilator and postbronchodilator spirometry; therefore, prebronchodilator subject numbers are smaller. Values are mean ± SD, No., or No. (%). CAT = COPD Assessment Tool; MRC = Medical Research Council.

were men. In the whole population, 558 of the participants (75%) had an abnormal CAT score of > 10, and 391 participants (50%) had an MRC score ≥ 3.

### Spirometry

Of the 753 participants who completed postbronchodilator spirometry, 148 (20%) did not perform prebronchodilator because they had taken inhaler(s) before the visit. In the 605 participants who completed both, prebronchodilator $FEV_1$ was 2.93 ± 0.93 L (86.9 ± 3.3% predicted) and increased to 3.07 ± 0.91 L (91.1 ± 22% predicted) postbronchodilator. Prebronchodilator FVC was 4.34 ± 1.11 L (106 ± 18.5% predicted) and increased to 4.47 ± 1.12 L (109.1 ± 18% predicted) postbronchodilator. $FEV_1$/FVC was 0.67 ± 0.12 prebronchodilator and 0.69 ± 0.11 postbronchodilator.

Of the participants, 313 (42%) had normal or restrictive spirometry, whereas 440 (58%) had airflow obstruction; the mean $FEV_1$/FVC was 0.58 ± 0.1. After bronchodilation, 260 participants (35%) had COPD, 112 (15%) had ACO, and 155 (21%) had asthma.

The LLN identified an additional 33 subjects with a postbronchodilator $FEV_1$/FVC ratio ≥ 0.7 but airflow obstruction consistent with COPD, increasing prevalence to 39%. The prevalence of either COPD or ACO was 49% or 54% when assessed using the LLN, respectively. No subjects with airflow obstruction using $FEV_1$/FVC < 0.7 had normal spirometry using the LLN. Seventeen participants were men and 16 were women, which equates to a false-negative rate of 8% in men and 16% in women.

Table 2 shows a comparison of the individuals with COPD, asthma, ACO, and none of these. The subjects with COPD and ACO had significant spirometric impairment, marked reduction in quality of life, and significant breathlessness.

### Drug and Tobacco Use

Of the study participants, 98% (773/789) had smoked heroin, with 389 (49%) still smoking. The remaining subjects either only smoked crack cocaine (n = 7), only injected heroin (n = 1), or did not complete that question (n = 8). Of the study participants, 83% (655/789) had smoked crack cocaine; however, only 189 (24%) still smoked the drug. Of study participants, 99% (779/789) had smoked cigarettes, with 697 (88%) still smoking. Of study participants, 83% (654/789) had smoked cannabis, with 226 (29%) still smoking. Of the participants, 312 (39%) had injected heroin intravenously. All but two subjects were currently prescribed methadone or buprenorphine at a mean dose of 43 ± 21 mg methadone per day.

**TABLE 2** ] Demographic, Symptom, and Spirometry Data Divided According to Diagnosis

| Characteristic | COPD (n = 260) | ACO (n = 112) | Asthma (n = 155) | Normal (n = 211) | *P* Value |
|---|---|---|---|---|---|
| Age, y | 49.3 ± 6 | 48 ± 5 | 46 ± 7 | 45.9 ± 6.5 | < .001[a] |
| BMI, kg/m$^2$ | 23.9 ± 4.7 | 24.6 ± 6.3 | 25.6 ± 6 | 26.2 ± 5.9 | < .001[a] |
| Oxygen saturation | 96 ± 2 | 96 ± 4 | 97 ± 1 | 97 ± 1 | < .001[b] |
| Postbronchodilator | | | | | |
| $FEV_1$ (L) | 2.45 ± 0.98 | 1.96 ± 0.85 | 3.16 ± 0.7 | 3.55 ± 0.8 | < .001[b] |
| $FEV_1$ (%) | 73.3 ± 25.2 | 63.5 ± 25.1 | 95.5 ± 17.1 | 103.7 ± 16.1 | < .001[b] |
| FVC (L) | 4.26 ± 1.2 | 3.6 ± 1.19 | 4.4 ± 1.02 | 4.64 ± 1.1 | < .001[b] |
| FVC (%) | 104.4 ± 21.5 | 97.1 ± 26.6 | 110.2 ± 15.1 | 110.8 ± 15.4 | < .001[b] |
| $FEV_1$/FVC | 0.56 ± 0.13 | 0.53 ± 0.12 | 0.73 ± 0.09 | 0.77 ± 0.04 | < .001[b] |
| MRC score (1-5) | 3.1 ± 1.3 | 2.9 ± 1.2 | 2.5 ± 1.2 | 1.9 ± 1 | < .001[a,c] |
| CAT score (0-40) | 22.9 ± 10.1 | 21.5 ± 10.4 | 19.6 ± 9.4 | 13.4 ± 9.2 | < .001[a,c] |
| Smoking pack-years | 31.8 ± 20.6 | 29.3 ± 16.7 | 27.3 ± 21.3 | 26.1 ± 19.1 | NS |
| Years smoking cigarettes | 34.1 ± 20.6 | 33.1 ± 6 | 30 ± 8 | 30 ± 7.8 | < .001 |
| Current cigarette smoker | 234 (90) | 98 (88) | 140 (90) | 187 (89) | NS |
| Heroin wrap-years | 23.8 ± 32.4 | 23.4 ± 34.3 | 27.1 ± 37.3 | 17.5 ± 24.3 | NS |
| Years smoking heroin | 24.5 ± 8.4 | 23.6 ± 8.1 | 21.3 ± 9.2 | 20.2 ± 9.2 | < .001[b] |
| Current heroin smoker | 151 (58) | 61 (54) | 71 (46) | 94 (45) | < .01[b] |
| Crack rock-years | 17 ± 27 | 17.7 ± 42.8 | 13.4 ± 20 | 15.7 ± 40.1 | NS |
| Years smoking crack cocaine | 14.6 ± 8.8 | 12.4 ± 8.2 | 14 ± 8.3 | 11.4 ± 8.1 | .03[d] |
| Current crack smoker | 64 (25) | 24 (21) | 45 (29) | 49 (23) | NS |
| Cannabis joint-years | 98.9 ± 177.8 | 64.6 ± 93.3 | 103 ± 159 | 80.7 ± 121.4 | NS |
| Years smoking cannabis | 21.3 ± 13.5 | 16.8 ± 13.9 | 20.3 ± 13.1 | 18.8 ± 12.4 | NS |
| Current cannabis smoker | 76 (29) | 24 (21) | 51 (33) | 64 (30) | NS |

Results are presented as mean ± SD, No. (%), or as otherwise indicated. Results for the 15 participants with restrictive spirometry are not included because of small numbers. ACO = asthma-COPD overlap; NS = not significant.
[a]In post hoc testing, participants with COPD differed from asthma and normal.
[b]In post hoc testing, participants with COPD and ACO differed from asthma and normal.
[c]In post hoc testing, participants with ACO differed from normal.
[d]In post hoc testing, participants COPD differed from the normal subjects but not those with asthma.

### *Relationship Between Drug Exposure and Airflow Obstruction/COPD*

There was no significant relationship between spirometric measures ($FEV_1$ [L], $FEV_1$ % predicted, and $FEV_1$/FVC) and tobacco/drug exposure (cigarette pack-years, heroin wrap-years, crack cocaine rock-years, and cannabis joint-years), whether this was examined in the whole group or the subjects with COPD.

### *Individuals With COPD*

COPD was mild ($FEV_1$ > 80% predicted) in 114 participants (44%), moderate ($FEV_1$ 50%-80% predicted) in 97 participants (37%), and severe or very severe ($FEV_1$ < 50% predicted) in 49 participants (19%).

Two hundred and twenty-six participants (86%) were current cigarette smokers, 151 (58%) were current heroin smokers, 64 (25%) were current crack smokers, and 76 (29%) were current cannabis smokers.

Thirty-four percent (n = 88) had previously been diagnosed with COPD, and 66% (n = 172) were diagnosed for the first time. Of the 172 newly diagnosed participants with COPD, 31 (18%) had previously been diagnosed with asthma. Table 3 shows the diagnosis before the study and the diagnosis after spirometry had been performed. Of the participants, 48% (81/169) previously labeled as having COPD had spirometry which was either restrictive, normal, or compatible with asthma.

Fifty-five percent of participants (n = 434) had been prescribed an inhaler on at least one occasion: 16% of the group with normal spirometry, 75% with asthma, 60% with ACO, 70% with COPD, and 80% with restrictive spirometry. Of people with COPD and an

**TABLE 3** ] Change in Diagnosis as a Result of Spirometry Testing

| | Diagnosis Before Study | | |
|---|---|---|---|
| | COPD (n = 169) | Asthma (n = 220) | Normal/No Diagnosis (n = 364) |
| Diagnosis after study | | | |
| COPD (n = 260) | 88 | 3 | 169 |
| ACO (n = 112) | 0 | 112 | 0 |
| Asthma (n = 155) | 28 | 98 | 29 |
| Normal (n = 211) | 48 | 0 | 163 |
| Restrictive (n = 15) | 5 | 7 | 3 |

See Table 2 legend for expansion of abbreviation.

MRC dyspnea score ≥ 3, 149 of 165 (90%) had been prescribed an inhaler on at least one occasion.

Table 4 shows the characteristics of participants with COPD according to COPD severity. There is a reduction in lung function, oxygen saturation, and quality of life and an increase in symptoms with increasing COPD severity.

## Discussion

Screening for COPD with spirometry anchored to community appointments is acceptable to drug users and associated with high completion rates. Just under one-half of this large population had fixed airflow obstruction with an $FEV_1/FVC < 0.7$, consistent with COPD or ACO with the proportion increasing to just over one-half when airflow obstruction was assessed using the LLN. Local service providers and commissioners should consider screening community drug service participants for COPD.

One concern with the only previous small study[6] was selection bias, with people with respiratory symptoms potentially more likely to participate, which may have inflated the number of people with COPD, other respiratory diseases, or respiratory symptoms. In contrast, we have shown that in a much larger population, where all individuals attending drug centers were given a screening appointment and three-quarters participated, around one-half had COPD or ACO. This rate of diagnosis far exceeds targeted screening of high-risk individuals with respiratory symptoms,[22-24] and the fact that most had relatively modest physiologic impairment provides the opportunity to intervene at a relatively early stage of disease. Less than 2% of subjects had restrictive spirometry, a figure much lower than seen in an older at-risk population,[25] increasing only to 3% when the Preserved Ratio Impaired Spirometry (PRISm) definition was applied, as with the COPDGene cohort.[26] An additional 20% of subjects without evidence of airflow obstruction had significant respiratory symptoms and impaired health status, something also seen in the COPDGene[27] and Subpopulations and Intermediate Outcome Measures in COPD Study (SPIROMICS)[28] cohorts. This merits further study. The higher COPD/ACO prevalence may relate to the participants' older average age and greater exposure to tobacco, cannabis, heroin, and crack cocaine than in the previous study.[6] Most people had incorrect prior diagnoses. Of particular note, just under one-half of the participants who had been told they had COPD had either asthma or no evidence of airflow obstruction. This highlights the need for spirometric testing because diagnosis, specifically COPD, cannot be established accurately based on symptoms alone.

In screening a much larger population, we could collect only a limited dataset. In the absence of detailed face-to-face review, there are challenges with diagnostic classification. Individuals with COPD have irreversible airflow obstruction, but this is also seen in people with asthma and fixed airflow obstruction presumably consequential to airway remodeling. We included prior diagnosis in our classification, and considered the 35% with fixed airflow obstruction and either a prior diagnosis of COPD or no past diagnosis of asthma were likely to have COPD. We have described an additional 14% with fixed airflow obstruction plus a past asthma diagnosis as ACO. The ACO cohort have a similar level of breathlessness, health status impairment, cigarette/drug exposure, and similar or worse spirometric impairment compared with the COPD cohort and differ from those with asthma, making it likely a considerable proportion will have COPD and an incorrect asthma diagnosis. A diagnosis of asthma may have been suggested because of their young age rather than a thorough investigation of whether or not they had evidence of reversible airflow obstruction and features of

**TABLE 4** ] Demographic, Symptom, and Spirometry Data Divided According to COPD Severity

| | Mild (n = 114) | Moderate (n = 97) | Severe and Very Severe (n = 49) | *P* Value |
|---|---|---|---|---|
| Age, y | 49 ± 5.9 | 48.9 ± 5.9 | 50.4 ± 6.2 | NS |
| BMI, kg/m$^2$ | 24.2 ± 4.1 | 24.2 ± 5.2 | 22.4 ± 4.5 | < .05[a] |
| Oxygen saturation | 97 ± 1 | 96 ± 2 | 95 ± 3 | < .001[b] |
| Postbronchodilator | | | | |
| $FEV_1$, L | 3.26 ± 0.66 | 2.18 ± 0.5 | 1.11 ± 0.39 | < .001[b] |
| $FEV_1$, % | 95.7 ± 11.1 | 66.9 ± 9.7 | 33.9 ± 10.5 | < .001[b] |
| $FEV_1$/FVC | 0.65 ± 0.04 | 0.56 ± 0.09 | 0.36 ± 0.09 | < .001[b] |
| MRC score (1-5) | 2.1 ± 1.1 | 3.1 ± 1.2 | 3.9 ± 1.2 | < .001[b] |
| CAT score (0-40) | 15.8 ± 9.2 | 24.1 ± 9.5 | 27.3 ± 9.4 | < .001[b] |
| Cigarette pack-years | 29.8 ± 20.5 | 34.1 ± 22.4 | 31.7 ± 16.6 | NS |
| Years smoking cigarettes | 33.5 ± 7.8 | 33.9 ± 6.6 | 35.9 ± 8 | NS |
| Heroin wrap-years | 23.7 ± 34 | 25.2 ± 34.3 | 21.3 ± 25.4 | NS |
| Years smoking heroin | 23.2 ± 9.1 | 25.7 ± 7.7 | 25.5 ± 7.6 | NS |
| Crack rock-years | 20.8 ± 31 | 16.5 ± 25.6 | 9.2 ± 16.3 | NS |
| Years smoking crack cocaine | 14.1 ± 8.4 | 15.9 ± 8.7 | 13.2 ± 11.3 | NS |
| Cannabis joint-years | 117.8 ± 173 | 109.2 ± 214.4 | 26.5 ± 34.1 | NS |
| Years smoking cannabis | 23.1 ± 12.4 | 21.1 ± 13.8 | 16.8 ± 15 | NS |

Results presented as mean ± SD or as otherwise indicated. Joint year = one joint per day for 1 y; Pack year = 20 cigarettes per day for 1 y; Rock year = 20 rocks per week for 1 y; Wrap year = 20 wraps per week for 1 y. See Table 1 and 2 legends for expansion of other abbreviations.
[a]In post hoc testing, people with severe or very severe COPD differ from mild COPD only.
[b]In post hoc testing, people with severe or very severe COPD differ from all other groups.

allergic (T helper cell type-2) inflammation, such as raised exhaled nitric oxide, blood eosinophil, or IgE levels. Consequently, we have reported COPD prevalence of at least 35%, but up to 49%, when ACO is included (39%-54% using the LLN rather than $FEV_1$/FVC < 0.7). Fifty-seven people (8%) have spirometric evidence of asthma (reversible airflow obstruction), with an additional 98 people having normal spirometry and a prior physician diagnosis of asthma, increasing asthma prevalence to 21%. Twenty percent of participants only had postbronchodilator spirometry, which adds to diagnostic uncertainty. Notwithstanding these challenges, the prevalence of COPD is very high, and at least two-thirds have airway disease.

There has been considerable focus on the link between health and social deprivation and difficult to reach populations who often have less healthy lifestyles, a high disease burden, engage poorly with screening and disease prevention initiatives, and die many years prematurely.[29] Heroin smokers are an example of such a population. Moving COPD screening to the point where individuals' access health care led to a high uptake, despite participants being offered a single appointment, by harnessing existing relationships we have demonstrated high uptake of a robust test acceptable to the population. The results of our screening have, in turn, highlighted an important health problem, a high rate of early disease, and a significant opportunity to intervene to improve symptoms (in light of significant underdiagnosis and treatment) and reduce risk (very high levels of ongoing cigarette smoking and heroin and/or crack smoking). The screening was acceptable to participants. The cost-effectiveness of such screening is yet to be established,[30] but we think that, in light of the very high prevalence of COPD and ACO, screening this population is justified. Initially, we sent the study results to each primary care physician and signposted the participant to existing services. We are currently investigating what impact that alone had on service utilization. We are now piloting a variety of different interventions targeted at those diagnosed with COPD and ACOS, including an enhanced smoking cessation intervention delivered at drug centers, treatment optimization clinic sessions at drug centers, and pulmonary rehabilitation programs specific for this cohort.

Considering near invariable polydrug use and subject numbers, it would have been surprising if there were clear relationships between length and quantity of exposure to an individual inhalant and lung function.

However, the duration of smoking cigarettes, heroin, and crack cocaine were associated with both COPD and ACOS, something not seen with cannabis. They were also more likely to still smoke heroin. This suggests that length of exposure rather than quantity of exposure is most important to the development of physiologic impairment. Compared with cigarette smokers, these individuals are more likely to develop COPD at a younger age, but whether smoking heroin (and crack) acts synergistically with cigarette smoke or has an additive effect, cannot be determined. Street drugs are typically cut/mixed with other substances. Determining what additional substances are smoked and their likely lung toxicity is an important area of study. All study participants smoked heroin from aluminum, and it may be that the additional toxicity relates to inhalation of heated vapor, which may contain aluminum oxide or fats used to coat aluminum. Establishing this could provide further insight into COPD pathogenesis. Our data are consistent with previous research that failed to establish a clear link between cannabis exposure and COPD.[31]

One challenge to examining the impact of drug exposure on health is the lack of quantification of exposure. Pack-years quantify cigarette exposure with accepted equivalents for rolling tobacco and cigars. Tashkin et al[32] proposed the joint-year to quantify marijuana exposure; however, the frequent mixing with tobacco provides an additional challenge. After discussion with drug service users, drug keyworkers, and colleagues concerning commonly accepted terminology and typical exposure, we propose the wrap-year and rock-year as measures of heroin and crack cocaine exposure with 1 year equivalent to smoking 20 wraps or rocks per week (approximately three per day) for a year, respectively. We hope this novel measure will allow better comparison between populations and research studies.

The study has a number of other weaknesses. Only a limited dataset, which was collected to limit the time participants were required to participate, and the absence of prescribing data prevent us assessing the level of pharmacologic (under) treatment. Lack of access to routine health records also prevents us examining uptake of other guideline-based treatments such as vaccination and pulmonary rehabilitation. Quantification of exposure is subject to recall bias; however, this is the case for all studies that assess cigarette/tobacco exposure. As yet, we have not been able to show the impact on subsequent uptake of treatment or change in risk exposure.

Our results show the merit in targeted screening of heroin smokers at their point of access to health-care services. This model of health-care delivery is applicable to other difficult to reach populations with a high burden of COPD.

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